"Advances in Ultrasonic NDE Methods II"

Time Frequency and Time Scale in Ultrasonics Techniques

Redouane Drai, Mohamed Khelil, Amar Benchaala and Malika Boudraa, Centre de Recherche Scientifique et Technique en Soudage et Contrôle (CSC),Algeria

ABSTRACT

In this paper, we contribute by the development of some signal processing techniques based on time frequency and Wavelet transform in order to enhance the sensibility of flaw detection, to measure thin materials thickness and to characterize defects in nature (plan or volumic).

INTRODUCTION

The Non Destructive Evaluation has to allow obtaining the highest possible detection probability, the most exact size and the exact orientation of dangerous defects that the specimen to test can contain. In reference [1], we contributed by some signal processing techniques such Hilbert transform, power cepstrum and correlation functions in order to improve defects detection probability and to identify cracks in materials.

In this paper, we contribute by the development of some signal processing techniques based on time frequency and Wavelet transform in order to enhance the sensibility of flaw detection, to measure thin materials thickness and to characterize defects in nature (plan or volumic).

1- The identification or the knowledge of detected defects nature is very difficult in Ultrasonic technique. This stage of the inspection is based on the experience of the expert controller. This one proceeds by changing the angle of ultrasonic beam and a lot of other tricks in order to find out a diagnosis on the defect nature: plan or volumic. This verdict is very important since norms and standard accept some volumic defects but refuse others plan defects. Therefore the acceptance or the refusal of defect could stop the functioning of an industrial installation. Analyses have been processed on examples of defects echoes detected in metallic pieces, showed clearly that one can describe defects waveforms by pertinent parameters permitting weld defects classification. So, discriminatory features from temporal and spectral signals of detected echo are extracted. The compact feature vector obtained is then classified by different methods: K Nearest Neighbour algorithm, statistical Bayesian algorithm and Artificial Neural Network. Other discriminatory features using discrete wavelet transform are extracted. Then, the obtained feature vector is also classified by the same algorithms. This system has correctly classified 95% of defects.

2- An algorithm based on wavelets is developed in order to enhance flaw visibility. So we show the application of these techniques on very absorbing materials containing defects.

3- Time frequency algorithms based on STFT, Wigner-Ville, Gabor transform are developed and applied to thin materials thickness measurement. Satisfactory results are obtained with Gabor transform in measurement of few tenth (0.1) mm.